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ENVIRONMENTAL CHARACTERISTICS FOR EM TECHNIQUES IN MCM

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LONG-TERM GOAL

The long term goal is to develop physics based models that will identify those spatial sediment properties which result in significant changes and/or errors in the parameters of the Navy's MCM environmental model. The Navy will be required to respond to regional conflicts throughout the world over the next several decades. The tactical support for these operations within littoral regions will require accurate and timely environmental information. This is especially important for amphibious warfare and associated Mine-Counter Measure (MCM) efforts. Specifically, mine burial (either by impact or sediment transport/scour) depends strongly on bottom sediment type. Electrical properties, combined with seismo-acoustic properties provide a rapid method to predict sediment characteristics that are related to mine burial and magnetic influence sweeping. Data to optimize the sweep parameters are currently available in very few geographic locations throughout the entire world with little (if any) data on temporal changes. Models will be developed that relate sediment characteristics to variations in the MCM environmental parameters.

SCIENTIFIC OBJECTIVE

Develop the technology to predict the spatial variations of electric properties of shallow marine sediments in a well defined geologic setting. Relate these variabilities to MCM environmental parameters to support Navy influence mine sweeping operations and next generation mine hunting systems.

APPROACH

The approach is to utilize frequency domain active electromagnetic sounding techniques to investigate the sub-bottom electrical properties in a well studied area. The electrical properties are determined by inverting the measured data for a simple layered model with the bottom electrical conductivity as a primary parameter. The electric conductivity of the bottom sediments can be related to the known geology and sedimentology of the area from other investigators. From the measured bottom properties, the spatial variation of the variability in MCM environmental parameters can be investigated. The first portion of the effort was devoted to the measurement of the electric and acoustic properties in a well studied and instrumented region during August 1996. This measurement area was located within ONR's STRATAFORM test area off the Eel River northern California which provided an ideal site with a wide variety of co-located academic investigations to define the geologic environment.

WORK COMPLETED

During the previous fiscal year we have accomplished all of the goals set forth. Preliminary models of the bottom electrical properties for the STRATAFORM area off the coast of Eureka CA were developed from available geologic information from STRATAFORM investigators. This model was used to predict the results of the active electromagnetic investigation and design the experiment to determine the sub-bottom parameters of interest. A ship towed electric source was developed to conduct the active source measurements required to determine sub-bottom electrical properties. Three combined electric and magnetic field recording systems were prepared for the experiment off the coast of Eureka. The measurement phase of the project was coordinated with related work of investigators from Scripps and Woods Hole. The three bottom-deployed receiver units were located near the STRATAFORM S60 site to take advantage of the extensive measurements conducted at this location. Towed-source track line were conducted radially over

the deployment locations to evaluate azimuthal dependencies of the bottom properties. The bottom-receiver instrumentation remained in place approximately three weeks before recovery. Data have been analyzed for the electrical properties of the bottom at two of the three sites. A paper (listed in references) has been developed and presented describing some of the initial results.

IMPACT/APPLICATION

This work is focused on relating the bottom electrical properties to the local sediment distributions and the influence these factor have on MCM operations. The connection between the sediment properties and the resulting MCM environmental parameters is poorly understood. Simple models are available to relate the geology to the MCM parameters, but the quality, reliability and variability of the resulting MCM parameters has not been determined.

TRANSITIONS

Data from this experiment have been transitioned to the NRL Multiple-Influence Detection task.
Plans are to transition the environmental models to MINEWARCOM through NO-96 6.4 to support performance predictions. In addition, the spatial variability in electrical properties will be included in the development of algorithms for a predictive capability that is being developed in the non-acoustic portion of the 6.2 Bottom Interaction Project

RELATED PROJECTS

Related projects include projects within the ONR STRATAFORM program which have initiated detailed studies of the geology and oceanographic properties, this includes the electromagnetic survey work of Rob Evans at the Woods Hole Institute of Oceanography. Additional related work at NRL is the Multiple-Influence Detection task which has investigated the effects of the environment on data fusion of different sensor types for ASW applications. This project has also worked closely with LeRoy Dorman at the Scripps Institute of Oceanography to incorporate seismic data into a data fusion detection technique.

REFERENCES

Avera, W., E. Mozley, and J. Reynaud, Controlled Source Electromagnetic Sounding off the Coast of Eureka California, MARELEC 97 conference, Imperial College, London England, June 1997.